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**GB 2327316 A** **US 6230006 A**  
**US 4314110 A**

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(54) Abstract Title: **Telecommunications services test apparatus**

(57) Telecommunications apparatus for testing telecommunications services and functions, such as voice mail and text messaging, which comprises an Any Network Access (ANA) device (5), voice mail platforms (3), a programmable switch (1), Message Storage Centre (MSC) (2), a Short Message Service Centre (SMSC) (14) and an External Short Message Entity (ESME) (6). The programmable switch causes a voice mail to be deposited at one of the voice mail platforms via the MSC. A confirmatory text message is then sent to one of the virtual mobile telephone numbers which is associated with that particular voice mail platform. The text message is then sent to the ESME via the ANA, and the ESME then notifies the programmable switch of receipt of the text message from a particular virtual number. The programmable switch can then verify that the audio message stored at the mail box was indeed that deposited.

Advantageously the multiple virtual telephone numbers of the ANA allows a network operator to test services and functions for a range of mobile telephone numbers without requiring a corresponding number of mobile telephones and attached equipments. The results of such testing can be used to produce operating statistics.

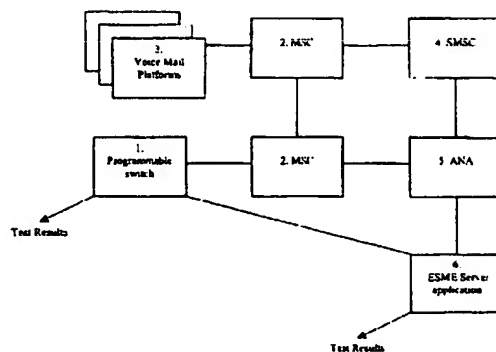


FIGURE 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date but within the period prescribed by Rule 25(1) of the Patents Rules 1995.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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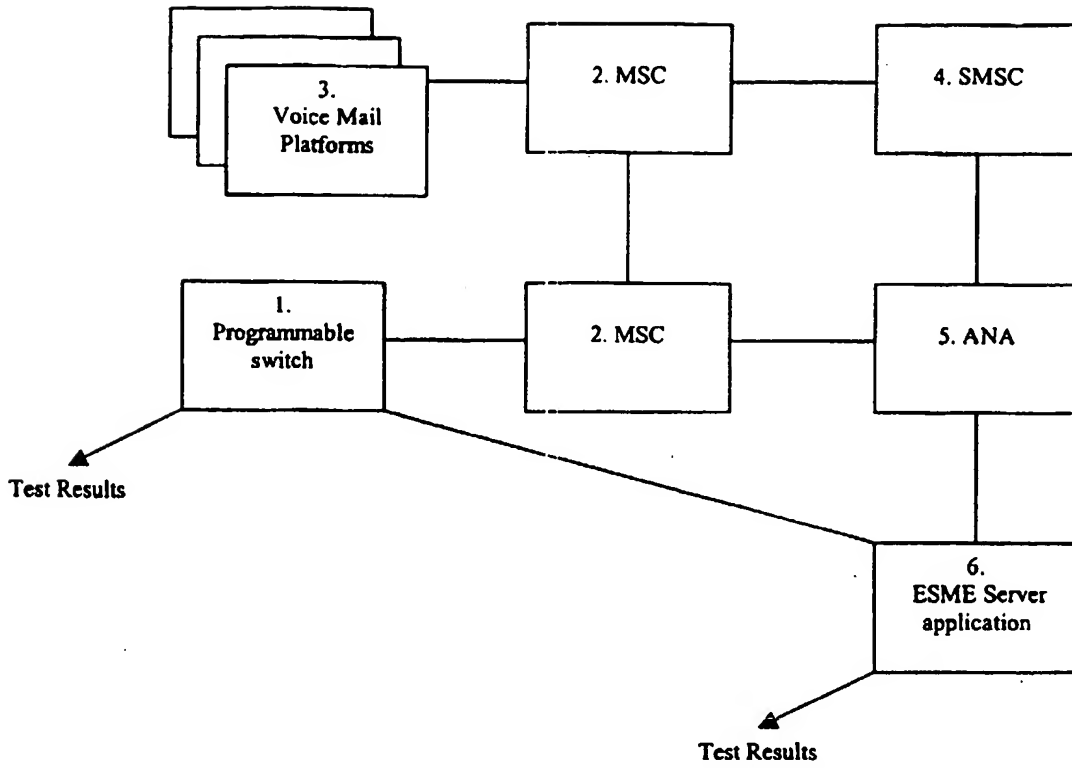


FIGURE 1

## TELECOMMUNICATIONS SERVICES APPARATUS

The present invention relates to the field of telecommunications and in particular, but not exclusively, to techniques for automated testing within mobile telephone networks.

- 5 Mobile telephone networks typically offer a wide variety of services to subscribers, often implemented using a range of different platforms, and maintaining a high Quality of Service to subscribers necessitates regular and thorough checking of the infrastructure. Even when all of the equipment appears to be working properly, it is often difficult to measure  
10 the effectiveness of service delivery, and operators often rely on fairly crude test metrics or customer complaints to determine when problems have arisen.

- Mobile network services typically provide either voice or text facilities to subscribers. Some services, such as voice mail may use a combination of  
15 voice and text features, for example text alerts may be used to indicate the presence of a new voice message, and it is for these types of services that it is often the most difficult for an operator to obtain performance statistics.

- Present regulatory environments in many countries require operators to  
20 produce statistics for operation of certain network facilities, and the regulator then publishes these. Generation of sufficiently accurate statistics for this purpose can be quite difficult and costly for network operators. The present invention seeks to provide a cost effective platform for testing a wide range of network facilities.

Although the invention is described in the context of the GSM mobile telecommunications system, but is also applicable to other types of mobile communication network.

The GSM Short Message service defines Mobile Originated and Mobile terminated Short Messages, which are respectively sent to and from a Short Message Service Centre (SMSC.) The SMSC used is normally one belonging to the network on which the sending user is registered. The address of the SMSC (or logical address of an SMSC group) is programmed into the user's terminal or Subscriber Identity Module (SIM.) Using this address, GSM mobile networks are able to route a Short Message to an appropriate SMSC, even if the message was initiated on another network.

In addition to person-to-person text messaging, networks also typically support person-to-machine and machine-to-person messaging, where the machine is usually an application running on an SMS host computer attached to the telephone network. These SMS hosts may be under control of the network operator, or may be operated by a third party and be connected to the mobile telephone network over a commercially controlled interface. These third party SMS hosts are known as ESMEs (External Short Message Entities.) Initially in GSM, it was only possible for a network's own subscribers to directly access that network's ESMEs.

More recently, techniques collectively known as Any Network Access (ANA) have been developed that overcome this restriction, allowing an ESME to offer services to the subscribers of any network, not just those of the network on which it is hosted. ANA allows applications or hosts to be addressed by using one or more virtual mobile telephone numbers, which fit into the numbering plan of the GSM system. Use of a

standardised telephone number allows hosts to be reached in the same way as a mobile telephone, with the voice call or text message being routable from any network. The ANA equipment appears to the network to behave as a network node with multiple virtual mobile telephones attached. Calls or messages sent to one of these virtual telephone numbers are routed to the ANA equipment. An ANA technique is described in a patent application no. WO 00/47004.

Traditional test methods for producing operating-statistics for a service such as voice mail rely on the use of individual mobile telephones. When connected to a computer these mobile telephones can be used to receive or generate text messages or voice calls under the control of a test application or program. One of the problems of this technique is that the mobile telephone can only carry one IMSI (International Mobile Subscriber Identity) and so can only test the behaviour of the service for a single simulated subscriber and mailbox. Since network services are often implemented using a large number of individual equipments, testing the service for a single subscriber may only test one of many such equipments. It is generally not practical to replicate the test equipment many times to solve this problem, due to cost, space and management considerations.

According to a first aspect of the invention there is provided telecommunications apparatus for use in a testing procedure, the apparatus comprising a router device which is provided with a plurality of associated telecommunications addresses, test control means for transmitting a test signal to telecommunications equipment to be tested, the apparatus being arranged such that, in use, the telecommunications equipment is configured to communicate with at least one of the telecommunications addresses on receipt of the test signal by the

equipment, and as a result of the equipment having so communicated with the router device, said router device is configured to transmit a response signal for use in a subsequent step of the testing procedure, the response signal being indicative of the equipment having received the test signal.

- 5 The present invention advantageously allows mobile network operators to cost-effectively implement end-to-end testing of services, including those that use a combination of voice and text. The testing process can be arranged to run continuously and can also be arranged to immediately alert the operator to failures or under-performance of one or more of the  
10 tested services.

The router device preferably comprises an Any Network Access (ANA) device, the ANA device being adapted to perform the function of receiving messages from a different mobile telecommunications network from the home mobile telecommunications network with which the ANA  
15 device is associated. Of particular importance is the ability of the ANA device to support virtual numbers.

The telecommunications equipment may communicate with the router device by way of transmitting a receipt signal which may or may not comprise that data which was sent to the equipment by the test control  
20 means.

The telecommunications equipment may comprise a plurality of telecommunication devices, each device being configured to communicate with at least one respective address of the router device.

The test signal may be representative of one or a combination of text  
25 (eg alphanumeric characters), graphics, audio or video.

According to a second aspect of the invention there is provided a method of testing telecommunications equipment comprising transmitting a test signal to telecommunications equipment which is to be tested, on receipt of the test signal by the telecommunications equipment arranging that the telecommunications equipment communicates with a router device, the router device being provided with a plurality of telecommunications addresses, as a result of the telecommunications equipment having so communicated with the router device arranging that the router device transmits a response signal for use in a subsequent step of the testing procedure, the response signal being indicative of the equipment having received the test signal.

The present invention may be viewed as solving the aforementioned problems by means of indirection, whereby one set of test equipment can be used to test the service for many mobile telephone numbers. One embodiment of the invention draws together the concepts of ANA and automated testing using a programmable switch.

A preferred embodiment of the invention comprises telecommunications services apparatus for use in testing services and components of a telecommunications network comprising a means for programmable call and text message generation and reception under the control of a test application, an Any Network Access (ANA) equipment including a Home Location Register function operable to direct to the apparatus the delivery of voice calls and text messages addressed within a range of virtual mobile telephone numbers, means for terminating voice calls and text messages so directed and means for communication between the call and text message termination means and the test application, the apparatus being operable to generate voice calls and text messages under

program control, to receive calls and text messages sent by system under test, and to communicate such reception to the test application.

The apparatus may include means for generation and detection of DTMF (Dual Tone Multi Frequency) tones or other suitable audio signals, so  
5 that recorded audio may be deposited and subsequently identified by the test application.

The apparatus may include a means for detection of voice activity, so that audio output from equipment under test may be detected.

In one embodiment of the invention, a programmable switch is used as  
10 the Call generation means and the platform for running the test application. The switch also collates the test results and writes appropriate logs. One or more of these switches may be connected into the telephone network at appropriate points (e.g. to MSCs) so that they can conveniently generate traffic for testing a network service or  
15 function.

The inventive test system may be configured to simulate the behaviour of almost any service, since services are typically characterised by a sequence of one or more voice calls or text message transmissions. For example a voice mail application is typically utilised in the following  
20 manner—

Caller makes Voice call to deposit message

Voice or text alert is sent to the mailbox owner, with retries at intervals

Voice call made from mailbox owner to retrieve the message, which should be the same as the originally deposited message



These steps are capable of being simulated by the invention by using an appropriate test application to generate this sequence of operations and to check the behaviour of the network and its components. Only one instance of the apparatus is required, yet the system is able to test the service on behalf of a range of mobile telephone numbers, since the test equipment may exercise instances of the service allocated to each of a range of virtual mobile telephone numbers recognised by the ANA component of the apparatus. These numbers may be allocated to physically separate equipments thereby enabling the test application to test the operation of the service on each of the physical equipments used to implement it. In the case of voice mail there could be several hundred individual equipments involved in providing the service, making this technique very attractive for providing good test coverage.

One key attraction of this technique is that the ANA component of the solution may be already installed in the network, and even if this is not the case, the installation of this invention would provide the means for implementing ANA as well.

According to a third aspect of the invention there is provided a machine readable data carrier which when loaded onto a computer implements the method of the second aspect of the invention.

One embodiment of the invention will now be described, by way of example only, with reference to the following drawing in which:

Figure 1 shows a block diagram of telecommunications testing apparatus in accordance with the invention.

The following example describes the use of the invention to test a voice mail application. This example provides both SMS and voice call usage

for illustrative purposes, but the invention is by no means limited to this application.

In this example, a number of test mailboxes are allocated on the voice mail platforms (3). These are preferably distributed across many or all of the physical voice mail equipments so as to obtain good test coverage. Each mailbox is allocated a mobile telephone number from a range of numbers which is part of the available ANA number range for this network. This means that HLR functionality for calls and messages being delivered to these numbers will be handled by the ANA system (5). The ANA system is configured so that text messages sent to one of the MSISDNs (Mobile Station ISDN numbers) allocated to voice mail will be delivered to the ESME server application (6) via the ANA system, while voice calls sent to one of these MSISDNs will be delivered to the programmable switch (1).

In a typical test scenario, a test application on the programmable switch dials out to one of the test mailboxes via an MSC (2.) The network uses its normal call routing mechanism to deliver the call to the appropriate voice mailbox. The programmable switch may then use its voice activity and/or tone detection features to determine that it has been correctly connected to a voice mailbox in deposit mode. The programmable switch then records a message on the mailbox, consisting of a determined set of DTMF tones, representing a signature for this call that the programmable switch will later use to check that it has retrieved the correct message.

After completion of the deposit call, the voice mail system should follow its normal procedure for alerting the mailbox owner to the presence of a new message. In this example, this is done by a text message alert sent to the MSISDN of the mailbox via an MSC (2) and SMSC (4). The SMSC queries the HLR function for the addressed MSISDN, which in this case

resides within the ANA system. The ANA system responds with routing information, which causes the SMSC to direct the short message to the ESME server application via the ANA system.

5 The ESME server application notifies the test application on the programmable switch that an alert has been received for a specified MSISDN. The programmable switch then responds to the alert by dialling the corresponding mailbox and generating DTMF tones (e.g. a command code and a PIN number) that cause the mailbox to enter retrieval mode. The programmable switch then checks that the DTMF tones recorded in  
10 the message correspond to those originally deposited.

All steps in the process are logged by the programmable switch and the ESME server application.

Benefits of the present invention include—

- 15 • Utilising existing ANA functionality where possible to provide a necessary and useful test capability for a range of MSISDNs
- Allowing the network operator to test services for a range of MSISDNs without requiring a corresponding number of mobile telephones and attached equipments.
- 20 • Providing independent testing and logging of a wide range of network services, under application program control
- Ability to test services automatically and continuously
- Ability to produce alarms when failures are detected

Although the invention is described in the context of the GSM mobile telecommunications system, it is also applicable to other types of mobile communication network.

**GLOSSARY**

ANA	Any Network Access. A method for allowing access to hosts from other networks
CLI	Calling Line Identity
ESME	External Short Message Entity, an equipment which acts as a Short Message receiver or transmitter.
MAP	Mobile Application Protocol
SMS	Short Message Service of the GSM mobile telephone system
SMS Host	Equipment for sourcing and sinking Short Messages for specific applications
SMSC	Short Message Service Centre
SS7	CCITT Signalling System no 7

## CLAIMS

1. Telecommunications apparatus for use in a testing procedure, the apparatus comprising a router device which is provided with a plurality of associated telecommunications addresses, test control means for  
5 transmitting a test signal to telecommunications equipment to be tested, the apparatus being arranged such that, in use, the telecommunications equipment is configured to communicate with at least one of the telecommunications addresses on receipt of the test signal by the equipment, and as a result of the equipment having so communicated with  
10 the router device, said router device is configured to transmit a response signal for use in a subsequent step of the testing procedure, the response signal being indicative of the equipment having received the test signal.
2. Telecommunications apparatus as claimed in claim 1 in which the router device comprises an Any Network Access (ANA) device, the ANA  
15 device being adapted to perform the function of receiving messages from a different mobile telecommunications network from the home mobile telecommunications network with which the ANA device is associated.
3. Telecommunications apparatus as claimed in claim 1 or claim 2 in which the telecommunications equipment communicates with the router  
20 device by way of transmitting a receipt signal.
4. Telecommunications apparatus as claimed in claim 3 in which the receipt signal comprises that data which was sent to the equipment by the test control means.
5. Telecommunications apparatus as claimed in claim 3 in which the  
25 receipt signal comprises does not comprise that data which was sent to the equipment by the test control means.

6. Telecommunications apparatus as claimed in any preceding claim in which the telecommunications equipment comprises a plurality of telecommunication devices, each device being configured to communicate with at least one respective address of the router device.
- 5 7. Telecommunications apparatus as claimed in any preceding claim in which the test signal is representative of one or a combination of text, graphics, audio or video.
- 10 8. A method of testing telecommunications equipment comprising transmitting a test signal to telecommunications equipment which is to be tested, on receipt of the test signal by the telecommunications equipment  
15 arranging that the telecommunications equipment communicates with a router device, the router device being provided with a plurality of telecommunications addresses, as a result of the telecommunications equipment having so communicated with the router device arranging that  
the router device transmits a response signal for use in a subsequent step of the testing procedure, the response signal being indicative of the equipment having received the test signal.
- 20 9. Telecommunications services apparatus for use in testing services and components of a telecommunications network comprising a means for programmable call and text message generation and reception under the control of a test application, an Any Network Access (ANA) equipment including a Home Location Register function operable to direct to the apparatus the delivery of voice calls and text messages addressed within a range of virtual mobile telephone numbers, means for terminating voice  
25 calls and text messages so directed and means for communication between the call and text message termination means and the test application, the apparatus being operable to generate voice calls and text messages under program control, to receive calls and text messages sent

by system under test, and to communicate such reception to the test application.

10. Telecommunications services apparatus as claimed in claim 9 which comprises means for generation and detection of DTMF (Dual  
5 Tone Multi Frequency) tones or other suitable audio signals, so that recorded audio may be deposited and subsequently identified by the test application.
11. Telecommunications apparatus as claimed in claim 9 which comprises means for detection of voice activity, so that audio output  
10 from equipment under test may be detected.
12. A machine readable data carrier which when loaded onto a computer implements the method as claimed in claim 8.
13. Telecommunications apparatus substantially as described and as shown in the accompanying Figures.
- 15 14. A method of testing telecommunications equipment substantially as described and as shown in the accompanying Figures.





INVESTOR IN PEOPLE

Application No: GB 0210629.2  
 Claims searched: 1 to 14

Examiner: Daniel Voisey  
 Date of search: 13 January 2003

## Patents Act 1977 : Search Report under Section 17

### Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1, 3 to 6 and 8	GB 2327316 A	(SCHLUMBERGER) see particularly page 2 paragraphs 1 to 3 and figures 1 and 2.
X	1, 3 to 6 and 8	US 4314110	(BREIDENSTEIN) see particularly column 1 line 51 to column 2 line 29.
A		US 6230006	(KEENAN) see column 4 line 56 to column 6 line 28.

### Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

### Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>y</sup>:

H4K

Worldwide search of patent documents classified in the following areas of the IPC<sup>y</sup>:

H04L, H04M, H04Q

The following online and other databases have been used in the preparation of this search report:

Online: WPI, EPODOC, JAPIO